

Occupational Competency As A Predictor of Labor Market Performance



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**OCCUPATIONAL COMPETENCY
AS A PREDICTOR OF
LABOR MARKET PERFORMANCE**

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OCCUPATIONAL COMPETENCY AS A PREDICTOR OF LABOR MARKET PERFORMANCE

Executive Summary

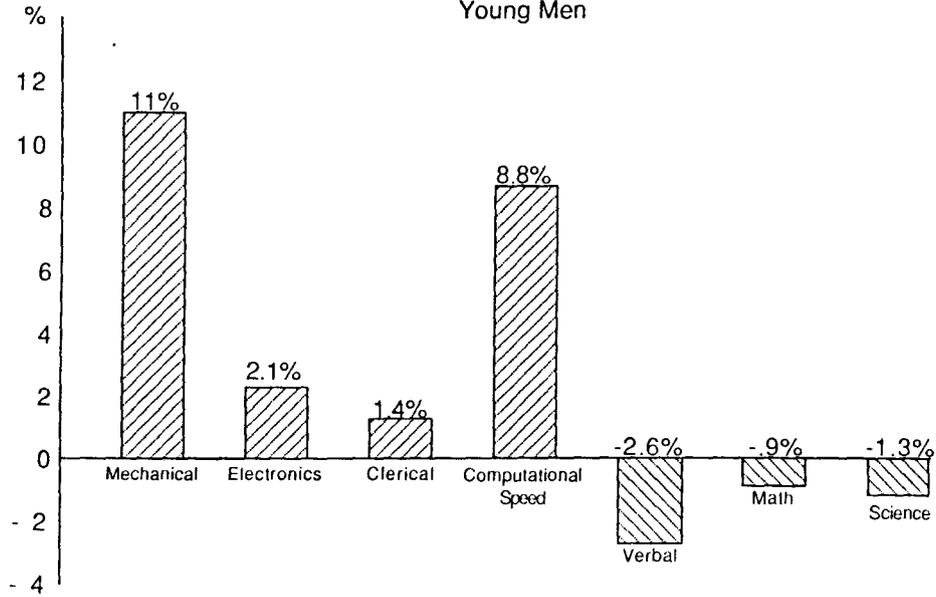
The paper examines the suitability of occupational competency measurement as a device for enhancing the accountability of vocational education programs.

In order for occupational competency tests to be used as program performance measures, they must be demonstrated to be valid predictors of labor market outcomes like earnings and wage rates and of job performance in appropriate occupations. The paper undertakes this task.

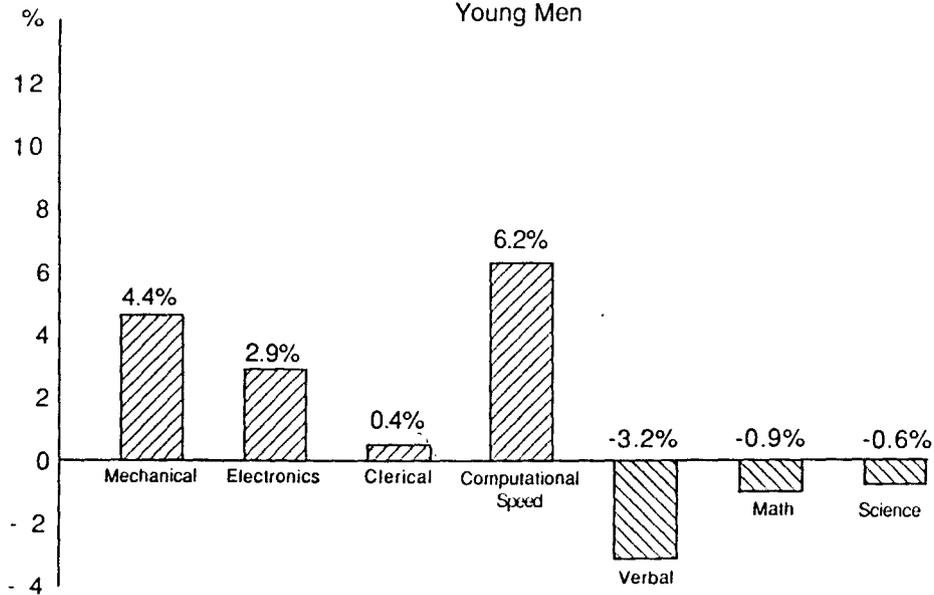
The first section of the paper analyzes the ability of the trade and technical subtests of the Armed Services Vocational Aptitude Battery, or ASVAB to predict short and intermediate term labor market outcomes such as wage rates and earnings of the National Longitudinal Survey's Youth Cohort. Representative findings from this analysis are presented in Figure 1-4. The trade and technical subtests of the ASVAB have very large effects on the wage rates and earnings of young men but have essentially no effects on the wages and earnings of young women. These effects are at least as large 6 years after taking the test as they were in 1980 when the test was taken. The second section of the paper (which is excerpted from another paper titled "The productivity consequences of what is learned in high school") presents evidence that the generic trade and technical competencies measured by the ASVAB also have major impacts on worker productivity in a broad family of military jobs involving the operation, maintenance and repair of complicated machinery and other technically oriented jobs. Since 80 percent of military jobs have close counterparts in the civilian sector, these findings imply that the trade and technical competencies measured by the ASVAB are also highly valid predictors of job performance in most blue collar and craft occupations.

The third section of the paper explores the impact of student participation in vocational education on gains in these generic vocational and academic competencies measured by the ASVAB. The results of this exploratory analysis appear to suggest that the effects of participation in vocational education on these generic skills are small. It appears that most of the effects of vocational education on labor market success do not operate through the generic technical knowledge and skills that the ASVAB subtests measure. This finding is consistent with previous research which has shown that they are

Effect of Competencies
on Earnings, 1984-1985
Young Men

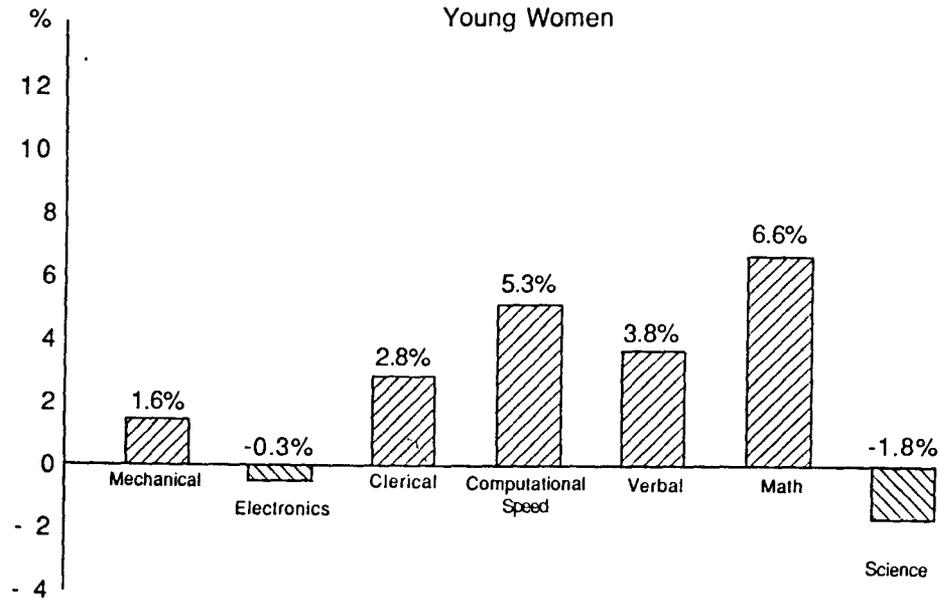


Effect of Competencies
on Wage Rates, 1983-1986
Young Men

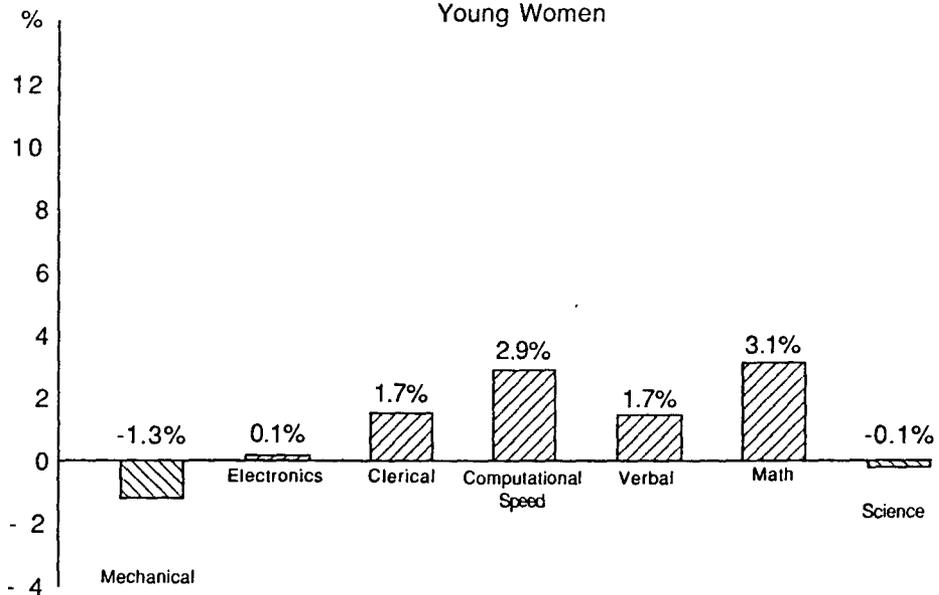


Source: Analysis of NLS Youth data. The figure reports the effect of a one population standard deviation increase in Armed Services Vocational Aptitude Battery subtest while controlling for schooling, school attendance, age, work experience, region, SMSA residence and ethnicity.

Effect of Competencies
on Earnings, 1984-1985
Young Women



Effect of Competencies
on Wage Rates, 1983-1986
Young Women



Source: Analysis of NLS Youth data. The figure reports the effect of a one population standard deviation increase in Armed Services Vocational Aptitude Battery subtest while controlling for schooling, school attendance, age, work experience, region, SMSA residence and ethnicity.

significant economic benefits to vocational education when a student obtains a training related job but essentially no benefits to vocational education if the student does not work in the field studied. Trade and industrial education raises the earnings of its graduates by teaching them skills in a particular occupational cluster and then placing them in one of those occupations. The universe of vocational/technical knowledge being sampled by the mechanical comprehension, auto and shop information and electronics subtests of the ASVAB is much boarder than the objectives of particular trade and technical programs. The result is that even when a program does a good job of teaching the knowledge and skills necessary for its cluster of occupations, it has a much more modest impact on the types of generic technical knowledge that are measured by the ASVAB composites.

Consequently, ASVAB subtests could never be used as the sole or primary indicator of the success of specific vocational programs. The subtests are much too short and superficial to be used as the sole indicator of occupational programs effectiveness. The three subtests combined contain a total of 70 ~~paper and pencil type~~ ^{multiple choice} items that are answered in a 39 minute time frame. It might be used, however, in conjunction with more focused assessment instruments developed for particular occupations. For students in the fields of trades and industry and technical occupations, the ASVAB subtests (or specially designed tests similar to them) might be used as indicators of a student's overall competence in the technical arena and as such might provide a way of recognizing which programs do the best job of teaching skills that are useful in a wide variety of mechanical and technical occupations.

The final section of the paper examines the validity and availability of occupationally specific competency tests that can be taken by vocational program completers in secondary and post secondary settings. Meta-analyses of the hundreds of studies of the validity of occupational competency tests have found that content valid occupational competency tests are highly valid predictors of job performance. When occupational competency tests appropriate for the job compete with academic ability tests in predicting job performance measured either by supervisory ratings or actual work samples, the occupational competency tests have about twice as large an effect as ability tests (Hunter, 1983). Since large improvements in job knowledge appear easier to achieve than equivalent (in proportions of a standard deviation) improvements in verbal and mathematical skills, occupationally specific training would appear to be highly desirable if the student is likely to put the knowledge to use by working in the occupation.

Comprehensive systems of occupational competency testing are now available from a variety of sources: the National Occupational Competency Testing Institute (NOCTI), the Instructional Materials Laboratory at Ohio State University, the New York State Education Department, the Vocational Technical Consortium of States (V-TECS), and the American Association for Vocational Instructional Materials (AAVIM) in Athens, Georgia. Oklahoma is currently validating a set of competency tests keyed to the objectives of its competency based curriculum guides. The great numbers of vendors supplying competency tests means that a federal mandate that states test the competency of their students would not prejudice the issue of what should be taught. Two of the competency testing programs--NOCTI and Oklahoma-- offer inexpensive hands-on-performance tests as one element of their competency testing system.

The state of Pennsylvania has established a **Pennsylvania Skills Certificate** which students may earn by passing both the written and hands-on components of the NOCTI Competency Exams. This certificate program has already stimulated changes in the curriculum. In the first year of testing, students did not do very well on the competency tests for clerical occupations. When causes of the deficiency were examined, it was discovered that the problem was not with the test but the curriculum which had become poorly aligned with current employer needs. The result has been a revision of the office education curriculum. The Pennsylvania's Skills Certificate is an excellent program and federal policy should endeavor to encourage other states to develop similar programs.

The major barrier to implementing performance measurement in vocational education and in other programs has been the unreliability and inappropriateness of the performance measures currently available. Training-related placement rates, currently reported to state departments of vocational education, are not comparable across districts and programs, are subject to manipulation, and suffer from serious nonresponse problems. Tests of generic and specific occupational competency avoid these problems: they are comparable across districts, manipulation can be prevented by developing alternate versions of the test and nonresponse can be easily minimized by making the test a part of the student's final grade in the course. Labor market outcome measures are influenced by environmental factors such as the state of the local economy which educators have no control over; competency test scores are not. The tests are cheap to administer. NOCTI charges only \$8.95-\$9.50 to supply and score its paper-and pencil exam and the costs of consumable materials for the hands-on performance test are only about \$6.00 on average.

There is always a danger that accountability systems based on outcomes will exacerbate existing incentives to cream the eligible population.⁸ This can be overcome by devising indicators of program performance which take into account the educational background of the students ~~in a program~~ ^{at the time} when they entered vocational education and by offering additional recognition (or larger reimbursements) for success with more challenging students -- the handicapped and those with low test scores or poor marks in junior high school.

One of the major benefits of using occupational competency testing to evaluate programs is the diagnostic information that analysis of the test results for individual performance objectives gives teachers and curriculum developers. When accountability systems based on training related placement rates and/or earnings gains (estimated from UI wage record data) signal that an individual program is performing poorly, they do not offer program operators a diagnosis of what is wrong. If placement rates are low, the natural tendency is to redouble placement efforts. While high school vocational education should increase its emphasis on placement into high wage jobs, there is a danger of overdoing this emphasis. If labor market outcomes are the only performance indicators, the placement director may be the only one made "accountable" by the system. The labor market is not so efficient that programs that do a poor job of teaching will inevitably find it impossible to place their graduates in training-related jobs. It would, therefore, appear desirable for occupational competency testing to be a component of state accountability system for vocational education.

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OCCUPATIONAL COMPETENCY AS A PREDICTOR OF LABOR MARKET PERFORMANCE

Vocational education programs funded under the Carl D. Perkins Act must demonstrate compliance with Federal mandates for program participation: target groups such as the physically handicapped and the economically disadvantaged must be served equitably. However, these programs currently are not assessed for their outcomes: funding is not contingent on evidence that program completers fare better in the job market than other students, or that program completers have acquired skills that are clearly linked to subsequent productivity. Because of the success with these types of outcome-based performance measures in other Federal grant-in-aid programs (such as the Job Training Partnership Act), Congress is now interested in possible methods of assessing high school vocational programs in terms of their impact on the earnings and employment experiences of graduates and on their competency and productivity on the job.

Performance measures that link high school course work to subsequent labor market experience and worker productivity are based implicitly on a human capital model: knowledge and skills gained in school are assumed to influence productivity, earnings and employment. However, other factors besides educational achievement may also be significant: for example, completion of a particular high school curriculum, and/or an individual's nonschool experiences, may provide signals to employers of that person's likely future productivity, regardless of his or her specific occupational competency. The question addressed by this paper is whether occupational knowledge is a reliable predictor of intermediate and long term labor market performance and whether tests are available which provide valid measures of occupational competency.

The paper begins by examining a specific battery of vocational and academic competency tests (the Armed Services Vocational Aptitude Battery, or ASVAB) and its ability to predict short and intermediate term labor market outcomes such as wage rates and earnings of the National Longitudinal Survey's Youth Cohort. The second section of the paper (which is excerpted from another paper titled "The productivity consequences of what is learned in high school") examines the impact of the various competencies measured by the ASVAB on job performance in military jobs which closely correspond to civilian jobs. The third section of the paper explores the impact of student participation in vocational education on gains in vocational and academic competency. The final section of the paper examines the current

availability of occupational competency tests that can be taken by vocational program completers in secondary and post secondary settings and the appropriateness of these tests for performance measurement in vocational education.

I. HOW WELL DOES THE LABOR MARKET REWARD THE VOCATIONAL COMPETENCIES MEASURED BY THE ASVAB?

The first task of the study is to determine to what degree the vocational competencies taught by high school vocational programs are rewarded by the labor market. This is accomplished by estimating models predicting the earnings, wage rate and unemployment as a function of competence in various vocational/technical fields while controlling for competence in the academic fields of mathematics, science and language arts, years of schooling, school attendance, ethnicity, age, work experience, marital status and characteristics of the local labor market.

1.1 DATA

The data set for this analysis is the Youth Cohort of National Longitudinal Survey (NLS)--all eight waves from 1979 to 1986. The measures of vocational and academic competence used in the study are derived from the Armed Services Vocational Aptitude Battery (ASVAB), a three hour battery of tests used by the armed forces for selecting recruits and assigning them to occupational specialties. The primary purpose of the ASVAB is to predict the success of new recruits in training and their subsequent performance in their occupational specialty. Its ability to accomplish these objectives has been thoroughly researched and the battery has been periodically modified to incorporate the findings of this research. The ASVAB Manual reports:

Extensive research demonstrates that the ASVAB composites used in military selection and classification predict performance in training for a variety of military occupations. (Booth-Kewley, 1983; Maier & Truss, 1983; Rossmeyssl, Martin & Wing, 1983; Wilbourn, Valentine, & Ree, 1984). For example, validity coefficients for electrical/mechanical equipment repair specialties range from .36 to .74; those for communication specialties range from .36 to .52; those for data processing specialties range from .39 to .77; and those for clerical and supply specialties range from .53 to .73. These coefficients have been corrected for restriction of range.¹

Eighty percent of the jobs held by enlisted personnel in the military have civilian counterparts so the research on the validity of the ASVAB in military settings generalizes quite well to the civilian sector (US Department of Defense, 1984). The test is highly correlated with the cognitive subtests of the General Aptitude Test Battery, a personnel selection test battery used by the US Employment Service, the validity of which has been established by studies of over 500 occupations. A validity generalization study funded by the armed forces concluded "that ASVAB is a highly valid predictor of performance in civilian occupations" (Hunter Crossen and Friedman, 1985, p. ix)

During the summer of 1980 all members of the NLS Youth sample were asked to take this test and offered a \$50 honorarium as an inducement. The tests were successfully administered to 94 percent of the sample. Testing was generally conducted in groups of 5 to 10 persons. The 1980 version of the ASVAB (Form 8A) was administered by staff of the National Opinion Research Corporation according to strict guidelines conforming to standard ASVAB procedures. The Department of Defense which funded this project had Dr. R. D. Bock an authority on educational and psychological testing evaluate the quality of the resulting ASVAB data. He concluded:

Data from responses of [the NLS Youth Sample] to the ASVAB are free from major defects such as high levels of guessing or carelessness, inappropriate levels of difficulty, cultural test-question bias, and inconsistencies in test administration procedures.²

The ASVAB test battery is made up of 10 subtests: Mechanical Comprehension, Auto and Shop Knowledge, Electronics Knowledge, Clerical Checking (Coding Speed), Numerical Operations (a speeded test of simple arithmetic), Arithmetic Reasoning, Mathematic Knowledge (covering the high school math curriculum), General Science, Word Knowledge and Paragraph Comprehension. A fuller description of each of these subtests together with sample questions is given in Appendix C.

The universe of skills and knowledge sampled by the mechanical comprehension, auto and shop information and electronics subtests of the ASVAB roughly corresponds to the vocational fields of trades and industry and technical so these subtests are interpreted as indicators of competence in these areas. Appendices D, E and F provide descriptions of the occupation specific competency examinations (together with sample questions) that have been

developed by the National Occupational Competency Testing Institute and by the states of Ohio and New York to assess the performance of their high school vocational students. By comparing the items included in these specially developed paper and pencil occupational knowledge tests with ASVAB items, it is possible to get a feel for how much overlap there is between the two types of tests. The difference between the tests appears to lie not in the nature of the items but rather in their difficulty and in the breadth of the occupational knowledge universe from which they are drawn. The vocational achievement exams designed for high school students assume the student has studied a particular occupational cluster in some depth under the tutelage of a teacher following the state's curriculum guide for the occupational cluster. The questions consequently ask for more detailed knowledge but from a narrower domain. The ASVAB items are from a broader domain than competency tests for individual occupations and individual items appear to be somewhat more generic. Consequently, the ASVAB subtests should be viewed as measures of knowledge, trainability and generic competence for a broad family of jobs involving the operation, maintenance and repair of complicated machinery and other technically oriented jobs. They do not measure competence in particular occupations like machinist or carpenter.

The analysis enters the electronics subtest and a composite of the mechanical comprehension and auto and shop knowledge subtests separately into the equation. This makes possible comparisons of the effects of the two competencies. Since the electronics subtest is much shorter than the other two tests in combination, it is likely to be a less reliable measure of the true competency in its area. This implies that even if the true impacts of the two competencies are equal the coefficient on the electronics test is likely to be smaller than the coefficients on the mechanical composite.

Competencies that are unique to clerical and retail sales jobs do not appear to be measured by the ASVAB. The ASVAB does contain a speeded clerical checking subtest which is intended for this purpose but validity studies of clerical jobs in the military have found that it does not add to the validity of composites based on verbal, arithmetic reasoning and mathematics knowledge subtests (Wise, Rossmeissl and Oppler, 1987). The clerical checking subtest is included in the analysis but it should not be viewed as a valid predictor of clerical competency.

Two dimensions of mathematical achievement are measured: the speed of doing mathematical computations is measured by the numerical operations subtest and mathematical reasoning ability is measured by a composite of the mathematics knowledge and arithmetic reasoning subtests. Science achievement is indexed by the general science subtest. Verbal achievement is measured by a composite made up of the word knowledge and paragraph comprehension subtests. These seven test composites have all been normalized to have zero mean and unit variance.

Four measures of labor market success are being studied: the log of the hourly wage rate in the current or most recent job, the log of calendar year earnings if they exceed \$500, earnings in dollars (with nonworkers over age 16 included in the sample) and the share of labor force time that the individual was unemployed (defined only for people who were in the labor force for at least 8 weeks during the calendar year).

An extensive set of controls are included in the estimating equations. Reports of weeks spent in employment are available all the way back through 1975. For each individual, these weeks worked reports were aggregated across time and an estimate of cumulated work experience (EXP_{it}) was derived for January 1 of each year in the longitudinal file. This variable and its square is included in every model as is age and its square. School attendance is controlled by four separate variables. The first variable indicates whether the youth is in school at the time of the interview. The second is a dummy variable indicating whether the youth has been in school since the last interview. The third is a dummy variable indicating whether the student is attending school part time. A positive coefficient is expected on this variable when the other controls for school attendance are entered in the model. The fourth variable is a measure of the share of the calendar year that the youth reported attending school derived from the NLS's monthly time log. Years of schooling is also controlled for by four variables: years of schooling, a dummy for high school graduation, years of college education completed, and years of schooling completed since the ASVAB tests were taken. Minority status is controlled by a dummy variables for Hispanic and for race. Characteristics of the local labor market held constant by entering the following variables: dummy variables for the four Census regions, a dummy variable for rural residence and for residence outside an SMSA and measures of the unemployment rate in the local labor market during that year.

1.2 HYPOTHESES AND ECONOMETRIC SPECIFICATION OF THE MODEL

The objective of the paper is to determine whether the vocational subtests of the ASVAB and by extension other similar paper and pencil tests of generic occupational knowledge are valid early indicators of a youth's short and intermediate term labor market success. This overall objective will be accomplished by testing a series of hypotheses relating to the impact of ASVAB subtest scores on wages, earnings and unemployment. For each hypothesis relating to the three vocational subtests, there is a corresponding hypothesis regarding the impact of the academic subtests. These hypotheses are specified and discussed below.

Main Effects of Test Scores

Hyp. V1: Subtests measuring generic vocational knowledge have positive effects on wage rates and earnings and negative effects on unemployment. Gender is likely to effect which tests are significant predictors of labor market success.

The primary reason for expecting tests of generic vocational knowledge to have positive effects on labor market success is the demonstrated positive effect of vocational course taking on labor market success when the student obtains a job which uses the skills learned in school (Bishop 1988) and the positive effect of content valid job knowledge test scores on supervisory ratings of job performance and work sample measures of worker productivity (Hunter 1983). Since vocational skills appear to payoff only when they are used, the returns to vocational skills are likely to be gender specific. Very few young men work in clerical jobs so the clerical checking subtest is not likely to a very useful predictor of wages and earnings for men. Very few young women have jobs for which knowledge of electronics, mechanical principles, auto mechanics and shop tools are essential, so the electronics and mechanical subtests are not likely to be good predictors of wages and earnings for women.

Hyp. A1: Subtests measuring academic competencies have small and sometimes negative effects on wage rate and earnings in the years immediately following high school graduation.

The reason for expecting the academic subtests to have small and possibly negative effects on labor market success is that analyses of other data sets such as High School and Beyond and NLS Class of 1972 have typically found that academic achievement test scores have small effects on early labor market success (Kang and Bishop 1986; Bishop, Blakemore and Low 1986, Meyer 1982).

One of the reasons this occurs is that vocational skills are more visible to employers than academic skills. Technical skills are easier to assess informally in the interview. Vocational teachers often help their students get jobs and in the process vouch for their competence. In contrast, most employers have little knowledge of job applicants' competence in math, science and reading. A survey of a stratified random sample of 2000 small and medium sized employers who are members of the National Federation of Independent Business found, for example, that aptitude tests had been given to only 3.2 percent of the new hires at these firms and high school transcripts had been obtained for only 13.7 percent of the new hires who had 12 or fewer years of schooling. As a result, the technical skills measured by the electronics, mechanical comprehension and auto and shop knowledge subtests may be better rewarded in the labor market than competence in math and science. These hypotheses are first tested in a model in which the various vocational and academic competencies are assumed to have linear and additive effects on labor market outcomes:

$$(1) \underline{Y}_t = a_t \underline{A} + b_t \underline{V} + g_t \underline{Z}_t + \underline{u}_t \quad \text{for } t = 1979 \dots 1986$$

where \underline{Y}_t is a vector of labor market outcomes (wage rates, earnings and unemployment) in year t .

\underline{A} is a vector of test scores measuring competence in mathematical reasoning, reading and vocabulary, science knowledge and speed of arithmetic computation,

\underline{V} is a vector of test scores measuring competence in three areas: (a) mechanical, auto and shop knowledge, (b) electronics and (c) clerical checking speed.

\underline{Z}_t is a vector of control variables such as age, work experience, schooling, school attendance, region, residence in an SMSA and local unemployment rate, and

\underline{u}_t is a vector of disturbance terms for each year.

The rest of the hypotheses to be tested relate to changes over time in the impact of vocational and academic competencies.

Calendar Time Interactions

hyp V2: The vocational subtests (which were taken at the end of 1980) should have smaller effects on labor market success in 1985/86 than in 1980/1981. This tendency for the impact of vocational tests to diminish with calendar time should occur even when the age of the workers is held constant.

hyp A2: Holding the age of the worker constant, the academic subtests should have smaller effects on labor market success in 1985/86 than in 1980/81.

The first reason for expecting the effect of vocational and academic test scores to diminish with calendar time is that competencies and knowledge change over time. The longer the time interval between taking a test and the point at which labor market outcomes are measured, the greater the opportunity for major changes in competencies and the less reliable the early test is as a measure of the individual's current competency level. This decline in reliability should lower the estimated coefficient on the test score. Counteracting this effect, is the possibility of secular trends or cyclical changes in the market return to vocational and academic skills. The payoff to vocational course work appears to be greater in the 1980s than in the 1970s (Bishop, 1988) and this suggests that the return to the vocational competencies measured by the ASVAB subtests may be growing as well. The payoff to years of schooling is also higher in the 1980s than in the 1970s suggesting that the return to academic competencies may also be rising.

To test these hypotheses a composite of the vocational subtests (TV) and a composite of the academic subtests (TA) were defined and then interacted with age deviated from 22, with actual work experience deviated from four years, with years of college and with current status as a student.

$$(2) Y_t = a_t A + b_t V + c_t TA + d_t TV + g_t Z_t + u_t$$

where $c_t = c_{1t}(Age_t - 22) + c_{2t}(Exp_t - 4) + c_{3t}(Student_t) + c_{4t}(Yrs\ of\ College_t)$

$$d_t = d_{1t}(Age_t - 22) + d_{2t}(Exp_t - 4) + d_{3t}(Student_t)$$

Exp_t = Cumulated years of work experience since age 17 as of "t"

$Student_t$ = proportion of the calendar year t attending school

When interactions are defined in this way, the main effects coefficients on the seven test scores (a_t and b_t) provide estimates for year t of the effect of the competency on labor market outcomes of 22 year old high school graduates who have had 4 years of real work experience and are not currently students. The coefficients on the interaction of age and the test composites (c_{1t} and d_{1t}) provide estimates of the effect of age on the payoff to academic and vocational competencies while controlling on work experience, years of college and student status. The coefficients on the interaction of work experience with the test composites (c_{2t} and d_{2t}) provide estimates of the effect of work experience on the payoff to academic and vocational competencies while controlling on age and years of college.

Age and the Payoff to Vocational Competence

hyp V3: Holding calendar year constant, the effect of vocational competency test scores on labor market success should be smaller for older workers and for workers with more than average work experience. $d_{1t} < 0$ and $d_{2t} < 0$.

The reason for expecting the effect of vocational competency tests to diminish as a worker ages is that most studies of the effect of course work have found that the large initial effects of vocational course work on wages and earnings diminish as the worker gets older (Meyer 1982; Kang and Bishop 1986). This is what one would expect if vocational courses serve as a signal of occupational competency but the signal has diminishing value as the individual gains post-school work experience. Meyer proposes an alternative explanation. He suggests that new hires who already have training in the occupation have less to learn so their performance and wages improve at a slower rate than the new hires who had no previous relevant training or experience. When, however, skill is defined by a generic occupational competency tests rather than by vocational courses taken, these explanations may not hold. When filling jobs that involve a great deal of on-the-job training, employers may give preference to job seekers who are already partially trained and who have demonstrated their ability to learn the skills required. If this is the way employers behave,

initial skill advantages may be magnified by a positive correlation with opportunities for further training on-the-job and initial rewards for occupational competency might grow with age.

Interactions with Student Status

The next set of hypotheses relate to the effect that being a student has on the payoff to academic and vocational competence. Students working during the summer or part time during the school year generally have a much narrower choice of occupations than young people who have completed their schooling. The high turnover rates and the necessity of scheduling work around school pushes students into occupations which tend not to give scope to the academic and vocational competencies measured by the ASVAB. This implies the following hypotheses:

hyp V4: The return to vocational competencies is less positive for students than for those who have completed their schooling.

$$d_3 < 0.$$

hyp A3: The return to academic competencies is less positive for students than for those who have completed their schooling. $c_3 < 0$.

hyp A4: Among students, high academic competencies are associated with lower earnings.

Young people with strong academic competency are typically faster learners than their peers and are consequently more likely to devote 100 percent of their time to study (eg. attend a college where students do a great deal of home work). Studies analyzing which students tend to devote the most time to jobs for pay have found that students with

low grades and academic test scores tend to work more than their peers who are doing better in school (Hotchkiss, Bishop and Gardner 1982).

Interactions with Years of College

Academic skills appear to be more critical to job performance in professional and managerial occupations than in blue collar and clerical occupations. This suggests the following hypothesis:

hyp A5: The return to academic competency is larger for college graduates than for high school graduates. $c_{4t} > 0$.

Analyses of the NBER/Thorndike data on men who were in the Air Force during World War II, supports this hypothesis but analyses of other data sets have been more equivocal (Taubman and Wales 1975; Hause 1975; Willis and Rosen 1979).

Age, Experience and the Payoff to Academic Competency

The final set of hypotheses relate to the effects of age and work experience on the return to academic competency.

hyp A6: The return to academic competency grows with the age of the worker. When $c_{2t} = 0$, $c_{1t} > 0$.

Numerous studies have found that the return to academic achievement increases with the age of the worker (Hauser and Daymont 1977; Taubman and Wales 1975). It is not clear, however, why this occurs. One possible explanation is that academic achievement may improve access to jobs offering considerable training and also enable the worker to get more out of the training. If this is the case, one would expect the payoff to academic skills to rise most rapidly for continuously employed workers. If the individual is not working, no such learning will occur, so the payoff to academic achievement will be unaffected by age if experience is controlled. This scenario implies the following hypothesis:

hyp A7: The return to academic competency grows with work experience but not with age when work experience is controlled. When both c_{1t} and c_{2t} are freely estimated, $c_{2t} > 0$ and c_{1t} is not significantly different from zero.

1.3 RESULTS

Main Effects of Test Scores

The results of estimating model 1 are presented in Table 1 through Table 4. Hypothesis V1 is strongly supported. For young men the ASVAB subtests measuring electronics knowledge and mechanical, auto and shop information have large and significant positive effects on wage rates and earnings and negative effects on unemployment. A one standard deviation increase in both of these test scores increases wage rates by 5.9 percent on average and increases log earnings by 13.1 percent on average. This is a very substantial return to achievement in these fields. These subtests had essentially no effect on the labor market success of young women.

The clerical checking subtest had weak positive effects on wage rates of young women and large significant effects on their earnings and unemployment. For young men, doing well on the clerical checking subtest appears to lower unemployment and increase earnings modestly but it has no effect on wage rates.

Hypotheses A1 is supported by the results for young men. Only computational speed has positive effects on labor market success of young men. The other three academic subtests have negative effects on wage rates and earnings and often positive effects on unemployment. In the log earnings models, 20 of 21 coefficients were negative. In the wage rate models, 23 of 24 coefficients were negative. In the unemployment models, 18 of 21 coefficients were positive and 6 were significantly positive at the 5 percent level.

For young women, hypothesis A1 appears to be rejected. Competence in mathematics computation and reasoning had substantial effects on wage rates and earnings of young women. In the wage rate models, 12 of 16 coefficients on the two math tests were significantly positive at the 10 percent level. In the log earnings models, 11 of 14 coefficients were statistically significant at the 5 percent level. A one standard deviation increase in both test scores increased wage rates by 5 to 8 percent and log earnings by about 10 percent.

